tion is considered, *relative contraindications*—including fractures located at the intended fixator pin insertion sites, most acetabular fractures, and many bilateral or complex fracture patterns—also must be considered. (Before emergent external fixation can occur, the AP pelvis x-ray film must be reviewed to determine if the pelvis is amenable to that treatment.)

A simple anterior fixator can be applied quickly. If applied incorrectly or if over-compressed, however, it can distract a more significant posterior injury. If this occurs, incomplete anterior reduction or supplemental posterior stabilization should be considered. External fixators have been designed to insert into the posterior sacroiliac joint region, which closes pelvic volume posteriorly and anteriorly. They are designed for rapid application during hemodynamic instability, but each requires experience in its application; additionally, they are only temporary stabilizers that should be removed within a few days, to avoid potential complications.

After obtaining adequate hemodynamic stability, the pelvic injury can be further evaluated for definitive management. In addition to the AP pelvis x-ray, radiographic inlet and outlet views and, occasionally, 45-degree oblique views of the pelvis are helpful in operative decisions and planning even when computed tomography (CT) scan results are available. When anterior injuries are identified on plain radiographs in patients with high-energy mechanisms of injury, a CT scan should be performed to determine the extent of the posterior injury.

The general principle for the definitive orthopedic management of pelvic injuries is to restore pelvic ring anatomy. This will provide stability and help to avoid deformity, which can lead to leg-length discrepancy or sitting problems, nonunion, and late instability or pain. Radiographic and physical examination of pelvic stability is necessary to determine whether surgical management is needed. A "stable" pelvic fracture is often amenable to bed rest until walking with support (for instance, using crutches, a walker, or a cane) is comfortable and weight bearing can be tolerated. These fractures must be followed closely with serial clinical and radiogaphic examinations to confirm their stability.

For the mechanically unstable or deformed pelvis, reduction and stabilization is necessary. Open reduction internal fixation is preferred, but the treatment depends on the patient and the injury. Internal, external, and percutaneous fixation techniques (including the best surgical approaches) have evolved over the past two decades and have shown improvements in patient outcomes. Newer techniques, such as percutaneous iliosacral screws, are providing less invasive options to achieve pelvic stability, but they, too, have potential risks.

Although many skilled surgeons could treat the pelvic injuries discussed here, it is important that patients with these injuries are treated at high-level trauma centers with established protocols. Even in the most ideal circumstances, patients who experience severe pelvic injuries continue to have high rates of morbidity and mortality. Decisions of whether to operate, when to operate, and which technique to use should be made by an orthopedic traumatologist trained in the management of severe pelvic injuries.

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The Use of Lasers in Musculoskeletal Disease

LASERS AND RELATED TECHNOLOGIES have recently been introduced for orthopedic surgery and for the treatment of pathologic musculoskeletal conditions. Half a dozen different kinds of lasers are used in surgery. The critical difference between the different kinds is the wavelength of light emitted, which affects both the interaction of the light beam with the tissue and the equipment needed to deliver the light to the target. A CO_2 laser beam is quenched in aqueous solution and requires gas insufflation of joints. Other lasers can use flexible fiber-optic delivery systems that function in saline.

The energy of the laser beam is typically converted to heat, depending on both the wavelength of the light and the magnitude of the light flux. At the highest intensities, tissue is ablated by vaporization. At the lower intensities, collagen can be denatured and reannealled, which results in the shortening and thickening of a section of a ligament, tendon, or capsule.

Lasers were first introduced as cutting instruments for resection of meniscal tears. In recent years, with the introduction of the holmium:YAG laser, near-infrared light energy has been used for arthroscopic resection of pathologic tissues. Laser-induced capsular shift procedures are now commonly performed for uni- and multidirectional instability of the shoulder, especially in high-level athletes. Less expensive thermal devices will most likely replace the laser for the thermal capsular shift procedures. In the field of spine surgery, lasers are being used in Europe for endoscopic resection of degenerative disks. Lasers have also been used to vaporize methyl methacrylate cement in hip revision surgery, but the toxicity of vaporization products has precluded widespread acceptance of this technique.

Recent reports have suggested a correlation between cases of osteonecrosis and arthroscopic laser use. Multiple retrospective reviews have presented conflicting results. Studies in pigs demonstrated the production of photo-acoustic pressure waves in subchondral bone, causing extensive subchondral hemorrhage when

the laser energy breached the subchondral bone. Additional wavelengths continue to be investigated and may provide additional cutting instrumentation in the future. Any new laser instrumentation must be economically feasible, however, to be accepted within the orthopedic community.

Photochemical techniques have also been recently adapted for treatment of rheumatoid arthritis. Photodynamic therapy is the destruction of pathologic tissue with light-activated photosensitizing chemicals, which selectively accumulate in the target tissue. Multiple chemicals are currently under development for the percutaneous and transcutaneous treatment of inflammatory synovium. Most light activation techniques incorporate use of low-energy laser devices. Although not actively in clinical use at this time, pre-clinical animal studies have shown promising results with both transcutaneous and fiberoptic percutaneous techniques.

Over the next several decades, we will most likely see the emergence of new light and optically based technologies for the treatment of musculoskeletal disease. While lasers will continue to be used as cutting devices, most advances will occur in areas of photochemistry and applied optics.

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Brachial Plexus Palsies in Neonates

THE INCIDENCE OF brachial plexus palsy after delivery remains 0.5 to 1 per 1,000 live births. The severity of the palsies, however, has decreased. Brachial palsies are most common in large babies, but they have even been seen in children delivered by Cesarian section. Most initial examinations show a completely flail upper extremity, but 70% to 90% of these palsies fully resolve. Unfortunately, there is no clear clinical or even laboratory measure that gives a sense of prognosis. Many children with no elbow function at 3 months develop it by 12 months to 18 months and then have a complete resolution of the palsy. Thus, whether to perform an exploration with nerve grafts or transplants at ages 3 months to 6 months is still debatable.

The initial management of these children should involve a complete range of motion of all digits and joints in the upper extremity. The goal is to start rehabilitation immediately. The exception is when the shoulder is painful because of an associated clavicle fracture or bleeding or swelling into the posterior triangle of the neck. In these patients, vigorous activities involving the shoulder would be inappropriate and should therefore be delayed for two weeks.

External rotation shoulder exercises are the most difficult to get families to do. In these exercises, it is not good enough just to abduct and rotate externally; therefore, the family should be instructed how to rotate externally with the arm against the chest. Families may need a demonstration of these exercises by a therapist, and the family need to meet with the therapist on a weekly basis, at least in the beginning. The success rates of electrical stimulation and other biofeedback types of therapy are unproven.

Despite therapy, two anatomical problems may gradually and progressively occur: the dislocation of the radial head, either anteriorly or posteriorly, and the dislocation of the humeral head, posteriorly. Because these possibilities exist, children who have persistent loss of motion should have roentgenograms of the elbow and the shoulder, including an axillary view, to rule out dislocations.

Residual disability of these children is difficult to clearly define in the first few years of life. New muscles can develop up to age 18 months and weak muscles can become strong enough to be considered normal up to age 4 years. None of these neonatal palsies results in a completely flail extremity. The most common residual, which was first described by Erb, involves weakness of shoulder abduction and external rotation with some weakness of elbow flexion, which may result in the posterior dislocation of the shoulder. We now know that this residual is best managed by a release of the internal rotators of the shoulder and a transfer of the latissimus dorsi and teres major about the shoulder to create external rotators. The elbow in children with an Erb's palsy may develop pronation flexion contractures that may even cause dislocation of the radial head posteriorly. We have recently learned that nothing should be done for these contractors, because they actually give the patient an advantage in flexion.

A rarer residual picture is that of a posterior spinal cord syndrome in which all the muscles enervated from the posterior cord nerves are paralyzed; this gives rise to weak abduction in the shoulder, extension of the elbow, and extension of the wrist and fingers. In these instances, transfers of the wrist flexors to finger extensors and an eventual glenohumeral fusion will improve function. Another rare outcome is that of the palsy of the muscles in the hand as first described by Klumpe, usually in children born breech with a stretch of the C-8 and T-1 nerve roots. Very few operative procedures will help these children, but the palsies can occasionally be bilateral and require a bracing system for children to function.

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